



AF/IPW

FEE TRANSMITTAL for FY 2005

Patent fees are subject to annual revision.

Complete if Known

Application Number	10/648,950
Filing Date	August 26, 2003
First Named Inventor	Michael Kozhukh
Examiner Name	Yevsikov, Victor V.
Art Unit	2891
Attorney Docket No.	42P13296D

☐ Applicant claims small entity status. See 37 CFR 1.27.

TOTAL AMOUNT OF PAYMENT (\$) 0.00

METHOD OF PAYMENT (check all that apply)

☐ Check ☐ Credit card ☐ Money Order ☐ None ☐ Other (please identify): _____
☒ Deposit Account Deposit Account Number: 02-2666 Deposit Account Name: Blakely, Sokoloff, Taylor & Zafman LLP

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☒ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, except for the filing fee
☒ Charge any additional fee(s) or underpayment of fee(s) under 37 CFR §§ 1.16, 1.17, 1.18 and 1.20. ☒ Credit any overpayments

FEE CALCULATION

1. EXTRA CLAIM FEES

Total Claims	Extra Claims	Fee from below	Fee Paid
16	20*	0	\$0.00
Independent Claims	3	0	\$0.00
Multiple Dependent			
Large Entity	Small Entity		
Fee Code	Fee Code	Fee Description	
1202 50	2202 25	Claims in excess of 20	
1201 200	2201 100	Independent claims in excess of 3	
1203 360	2203 180	Multiple Dependent claim, if not paid	
1204 300	2204 150	**Reissue independent claims over original patent	
1205 300	2205 150	**Reissue claims in excess of 20 and over original patent	
SUBTOTAL (1)		(\$)	0.00

**or number previously paid, if greater, For Reissues, see below

2. ADDITIONAL FEES

Large Entity	Small Entity	Fee Description	Fee Paid
Fee Code	Fee Code		
1051 130	2051 65	Surcharge - late filing fee or oath	
1052 50	2052 25	Surcharge - late provisional filing fee or cover sheet.	
2053 130	2053 130	Non-English specification	
1251 120	2251 60	Extension for reply within first month	
1252 450	2252 225	Extension for reply within second month	
1253 1,020	2253 510	Extension for reply within third month	
1254 1,590	2254 795	Extension for reply within fourth month	
1255 2,160	2255 1,080	Extension for reply within fifth month	
1401 500	2401 250	Notice of Appeal	
1402 500	2402 250	Filing a brief in support of an appeal	
1403 1,000	2403 500	Request for oral hearing	
1451 1,510	2451 1,510	Petition to institute a public use proceeding	
1460 130	2460 130	Petitions to the Commissioner	
1807 50	1807 50	Processing fee under 37 CFR 1.17(q)	
1806 180	1806 180	Submission of Information Disclosure Stmt	
1809 790	1809 395	Filing a submission after final rejection (37 CFR § 1.129(a))	
1810 790	2810 395	For each additional invention to be examined (37 CFR § 1.129(b))	
Other fee (specify)			
SUBTOTAL (2)		(\$)	

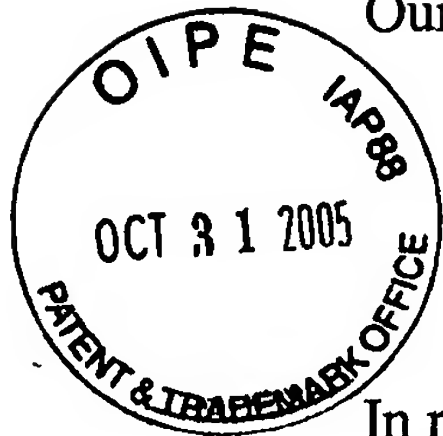
SUBMITTED BY

Complete (if applicable)

Name (Print/Type)	Ashley R. Ott	Registration No. (Attorney/Agent)	55,515	Telephone	(303) 740-1980
Signature		Date	10/27/05		

RESPONSE UNDER 37 C.F.R. § 1.116
-- EXPEDITED PROCEDURE --
EXAMINING GROUP 2800

Our Docket No.: 42P13296D



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Kozhukh

Application No.: 10/648,950

Filed: August 26, 2003

For: Interconnect Structures in
Semiconductor Device and Processes of
Formation

Examiner: Yevsikov, Victor V.

Art Group: 2891

RESPONSE AFTER FINAL

Mail Stop: AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Final Office Action mailed on August 30, 2005, which was made final, applicant submits this Amendment After Final Action for consideration.

FIRST CLASS CERTIFICATE OF MAILING/FACSIMILE

I hereby certify that I am causing the above-referenced correspondence to be facsimile transmitted and to be deposited with the United States Postal Service as first class mail with sufficient postage on the date indicated below and that this paper or fee has been addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

October 27, 2005

Date of Deposit

Leah Schwenke

Name of Person Mailing Correspondence

Signature

October 27, 2005

Date

Docket No.: 42P13296D

Application No.: 10/648,950

In the specification:

Please replace paragraph [0025] with the following amended paragraph:

[0025] The particular combination of metal layers and processing steps described in the foregoing embodiment results in the formation of a silver interconnect which may be utilized in a variety of integrated circuit structures. One example of the utilization of the silver interconnect structure and process of the invention is illustrated in FIG. 7. Referring to FIG. 7, after transistor 140 and field isolation regions 132 have been formed, an interlevel dielectric layer 160 is formed overlying transistor 140 and field isolation regions 132. In one embodiment, interlevel dielectric layer 160 comprises dielectric layer 142, etch stop layer 144 and dielectric layer 146.

Please replace paragraph [0028] with the following amended paragraph:

[0028] A portion of dielectric layer 146 and a portion of etch stop layer 144 are then removed to expose a portion of via plugs 152 and form interconnect opening. Interface layer 158 is formed in accordance with the previously described processing steps and directly overlies the exposed portion of via plugs 152. A silver interconnect 154 is then formed in accordance with the previously described processing steps. Via plugs 152 enables a subsequently deposited conductive layer 156 to be electrically coupled to source/drain regions 134 of the transistor 140 through silver interconnect 154 and interface layer 158. It would be appreciated that the foregoing process steps may be repeated in order to fabricate additional levels of conductive interconnects.

Please replace paragraph [0040] with the following amended paragraph:

[0040] During the UV lithography process, a photoresist mask 210 is placed directly on the surface of silver layer 206 without an antireflective coating, as illustrated in FIG. 12. The photoresist mask 210 is then exposed to UV light. As a result, the chemical structure of some of the photoresist mask 210 materials are changed. After a developing process, only a portion of the mask 210 that covers the interconnect is remained. Other lithography process may be employed.

Please replace paragraph [0042] with the following amended paragraph:

[0042] After the interconnect 218 is formed, a protection layer 212 is deposited overlying the silver layer 206 and the interface layer 216, as illustrated in FIG. 16. The protection layer 212 is formed to prevent silver layer 206 from diffusion into other materials, such as dielectric layer 214 of FIG. 18. In one embodiment, protection layer 212 ~~protection layer 214~~ may be a layer of titanium. In an alternative embodiment, protection layer 212 ~~protection layer 214~~ may be a layer of titanium nitride or tantalum nitride. In a further alternative embodiment, the protection layer may be a layer of tungsten. Other materials that prevent silver diffusion may be utilized as a protection layer.

In the claims:

For the Examiner's convenience, all pending claims are presented below with changes shown in accordance with the mandatory amendment format

1. (Previously Presented) A process, comprising:

providing a device substrate having a dielectric layer thereon;

removing a portion of the dielectric layer to create an opening;

forming an interface layer within the opening;

forming a silver layer overlying the interface layer;

annealing the substrate to form an intermetallic layer between the silver layer and the

interface layer, in which the silver layer is in intimate contact with the

intermetallic layer; and

forming a protection layer overlying the silver layer which is thick enough to prevent the

silver layer from diffusing into other materials.
2. (Original) The process of claim 1, further comprising removing portion of the silver

layer, intermetallic layer, and the interface layer overlying the dielectric layer to form a

smooth surface.
3. (Original) The process of claim 1, wherein the interface layer comprises an adhesion

layer and a diffusion barrier layer overlying the adhesion layer.
4. (Original) The process of claim 3, wherein the diffusion barrier layer comprises

titanium nitride or tantalum nitride.

5. (Original) The process of claim 3, wherein the adhesion layer comprises titanium, tungsten, aluminum, or titanium nitride.
6. (Original) The process of claim 1, wherein the interface layer is formed using sputter deposition process.
7. (Original) The process of claim 1, wherein the silver layer is formed using sputter deposition process.
8. (Original) The process of claim 1, wherein the substrate is annealed at an ambient temperature of approximate 400 degree Celsius for a period of approximate one hour.
9. (Original) The process of claim 2, wherein the removing comprises a chemical-mechanical-polishing (CMP) process.

10-23. (Cancelled)

24. (Previously Presented) An interconnect structure, comprising:
 - a device substrate;
 - an interface layer overlying the device substrate;
 - a silver layer overlying the interface layer;
 - a protection layer overlying the silver layer which is thick enough to prevent the silver layer from diffusing into other materials; and

a dielectric layer overlying the protection layer.

25. (Original) The interconnect structure of claim 24, wherein the interface layer comprises an adhesion layer and a diffusion barrier layer overlying the adhesion layer.

26. (Original) The interconnect structure of claim 25, wherein the diffusion barrier layer comprises titanium nitride or tantalum nitride, and wherein the adhesion layer comprises titanium, titanium nitride, aluminum, or tungsten.

27. (Original) The interconnect structure of claim 24, wherein the protection layer comprises titanium, titanium nitride, or tungsten.

28. (Previously Presented) An interconnect structure, comprising:

- a device substrate;
- a dielectric layer overlying the device substrate, the dielectric layer having a cavity therein;
- an interface layer overlying the dielectric layer, the interface layer having a thickness insufficient to completely fill the cavity;
- a silver layer overlying the interface layer, the silver layer having a thickness sufficient to completely fill the cavity; and
- a protection layer overlying the silver layer which is thick enough to prevent the silver layer from diffusing into other materials.

29. (Original) The interconnect structure of claim 28, wherein the interface layer comprises an adhesion layer and a diffusion barrier layer overlying the adhesion layer.

30. (Original) The interconnect structure of claim 29, wherein the diffusion barrier layer comprises titanium nitride or tantalum nitride, and wherein the adhesion layer comprises titanium, titanium nitride, aluminum, or tungsten.

Remarks

Applicant respectfully requests reconsideration of this application as amended. The specification has been amended. No claims have been amended, cancelled, or added. Therefore, claims 1-9 and 24-30 are presented for examination.

35 U.S.C. §112 Rejection

Claims 1, 24 and 28 stand rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement.

More specifically, the Office Action asserts that the applicant added a limitation to a protection layer that has no support in the specification. The Office Action states “[t]he claims are drawn to embodiments described in figs. 1-7. However, the specification does not set forth any protection layer in relation to these first two embodiments – only in relation to the third embodiment of figs. 13-19, that are directed to the non-damascene wiring layer.” (Final Office Action mailed 8/30/05 at pg. 2.)

Firstly, the Office Action asserts that the embodiments of figures 13-19 are directed to a “non-damascene wiring layer”. Applicant assumes that the term “non-damascene” is referring to a non-etched or non-inlaid silver interconnect structure. Applicant respectfully asserts that nowhere in the present application are the embodiments relating to figures 13-19 referenced or referred to as a “non-damascene wiring layers”. Applicant has not limited these embodiments to that particular description.

Secondly, applicant submits that the protection layer feature added to claims 1, 24, and 28 does have support in the specification. Although, the description of the

protection layer was described in relation to figures 8-19 of the present application, the application does state:

In the foregoing specification, the invention has been described with reference to specific exemplary embodiments thereof. It will be evident that various modifications may be made thereto without departing from the broader spirit and scope of the invention as set forth in the following claims. The specification and drawings are, accordingly, to be regarded in an illustrative sense rather than a restrictive sense.

Specification at page 17, paragraph [0049] (emphasis added).

Referring to page 15, paragraph [0042], line 2, of the present application, it is disclosed that a protection layer is formed *to prevent a silver layer from diffusing into other materials*. Claim 1 also provides that the protection layer is provided to prevent a silver layer from diffusing into other materials. Accordingly, applying a protection layer over the silver layer of figures 1-7 serves the purpose of preventing silver layer 110 from diffusing into other materials (such as the conductive layer 156), similar to preventing silver layer 206 from diffusing into other materials (such as dielectric layer 214).

As it was provided in the present application that the particular embodiments of the invention may have modifications made thereto and that the specification and drawings are to be regarded in an illustrative rather than restrictive sense, it follows that applying a protection layer overlying the silver layer 110 provided with respect to figures 1-7 would be supported claim subject matter for the present application. The feature of protection layer should not be solely limited to the specific embodiment provided by figures 8-19, as this was not contemplated by language of the present application. Therefore, applicant respectfully submits that the claims of the present application are allowable.

Specification

The specification is objected to because in Figure 7, numeral 156 is not described in the specification. The specification has been amended to correct this omission.

The specification is objected to because at page 15, paragraph [0042], line 4, the words “protection layer 214” should refer to numeral 212. The specification has been amended to correct this error.

The specification is objected to because at page 15, paragraph [0042], line 5, the words “protection layer 214” should refer to numeral 212. The specification has been amended to correct this error.

Therefore, applicant respectfully requests that the objections to the specification be withdrawn.

Drawings

The drawings are objected to as failing to comply with 37 CFR §1.84(p)(5) because they include the following reference character(s) not mentioned in the description: layer 156, fig. 7. The specification has been amended to refer to this reference character. Therefore, applicant respectfully requests that the objections to the drawings be withdrawn.

Applicant respectfully submits that the rejections have been overcome and that the claims are in condition for allowance. Accordingly, applicant respectfully requests the rejections be withdrawn and the claims be allowed.

The Examiner is requested to call the undersigned at (303) 740-1980 if there remains any issue with allowance of the case.

Applicant respectfully petitions for an extension of time to respond to the outstanding Office Action pursuant to 37 C.F.R. § 1.136(a) should one be necessary. Please charge our Deposit Account No. 02-2666 to cover the necessary fee under 37 C.F.R. § 1.17(a) for such an extension.

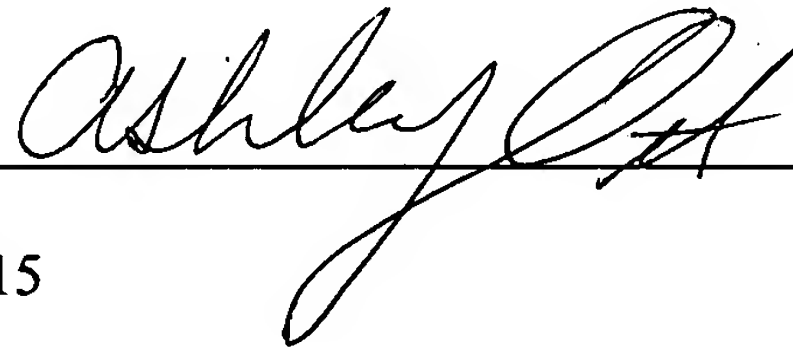
Please charge any shortage to our Deposit Account No. 02-2666.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Date: October 27, 2005

Ashley R. Ott
Reg. No. 55,515

A handwritten signature in cursive script, appearing to read 'Ashley Ott', is written over a horizontal line.

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